

PATENT COOPERATION TREATY
PCT
INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

REC'D 13 NOV 2001

WIPO

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Applicant's or agent's file reference 40443295	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International Application No. PCT/AU00/00683	International Filing Date (<i>day/month/year</i>) 16 June 2000	Priority Date (<i>day/month/year</i>) 18 June 1999
International Patent Classification (IPC) or national classification and IPC Int. Cl. ⁷ C09K 17/06, 17/02; C05G 3/04; C05D 3/02		
Applicant ULTIMATE PRODUCTS (AUST) PTY LTD et al		

1.	This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.																									
2.	This REPORT consists of a total of 7 sheets, including this cover sheet. <input type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT). These annexes consist of a total of sheet(s).																									
3.	This report contains indications relating to the following items: <table border="0"><tr><td>I</td><td><input checked="" type="checkbox"/></td><td>Basis of the report</td></tr><tr><td>II</td><td><input type="checkbox"/></td><td>Priority</td></tr><tr><td>III</td><td><input type="checkbox"/></td><td>Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</td></tr><tr><td>IV</td><td><input checked="" type="checkbox"/></td><td>Lack of unity of invention</td></tr><tr><td>V</td><td><input checked="" type="checkbox"/></td><td>Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</td></tr><tr><td>VI</td><td><input checked="" type="checkbox"/></td><td>Certain documents cited</td></tr><tr><td>VII</td><td><input type="checkbox"/></td><td>Certain defects in the international application</td></tr><tr><td>VIII</td><td><input checked="" type="checkbox"/></td><td>Certain observations on the international application</td></tr></table>		I	<input checked="" type="checkbox"/>	Basis of the report	II	<input type="checkbox"/>	Priority	III	<input type="checkbox"/>	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability	IV	<input checked="" type="checkbox"/>	Lack of unity of invention	V	<input checked="" type="checkbox"/>	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement	VI	<input checked="" type="checkbox"/>	Certain documents cited	VII	<input type="checkbox"/>	Certain defects in the international application	VIII	<input checked="" type="checkbox"/>	Certain observations on the international application
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Date of submission of the demand 16 January 2001	Date of completion of the report 5 November 2001 - 8 NOV 2001
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer N.L. KING Telephone No. (02) 6283 2150

I. Basis of the report1. With regard to the **elements** of the international application:*

- ☒ the international application as originally filed.
- ☐ the description, pages , as originally filed,
 pages , filed with the demand,
 pages , received on with the letter of
- ☐ the claims, pages , as originally filed,
 pages , as amended (together with any statement) under Article 19,
 pages , filed with the demand,
 pages , received on with the letter of
- ☐ the drawings, pages , as originally filed,
 pages , filed with the demand,
 pages , received on with the letter of
- ☐ the sequence listing part of the description:
 pages , as originally filed
 pages , filed with the demand
 pages , received on with the letter of

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

4. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/fig.

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☐ restricted the claims.
- ☐ paid additional fees.
- ☐ paid additional fees under protest.
- ☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- ☐ complied with.
- ☒ not complied with for the following reasons:

Claim 1 is directed to an aqueous dispersion of calcium carbonate and sulphur, the atomic ratio of calcium to sulphur being limited to a particular range.

Claim 8 is directed to an aqueous suspension of rock lime of defined particle size.

Claim 1 makes no reference to particle size while in claim 8 there is no mention of sulphur in the appropriate atomic ratio to calcium.

Because the search covered both the above aspects no invitation to pay additional fees was issued.

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☒ all parts.
- ☐ the parts relating to claims Nos.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 1-7, 14-17	YES
	Claims 8-13	NO
Inventive step (IS)	Claims 1-7, 14, 16	YES
	Claims 8-13, 15, 17	NO
Industrial applicability (IA)	Claims 1-17	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

Documents Cited in the International Search Report and Invoked Here:-

D1 AU 36066/97

D2 FR 2372131 ✓

D3 CA 2044048

D4 DE 3628611 ✓

New Citations:-

D5 US 3989195 ✓

D6 US 3797610 ✓

EP 924176

NOVELTY(N) and INVENTIVE STEP(IS) Claims 1-7, 14 and 16 :-

Claim 1 defines an aqueous dispersion of calcium carbonate and sulphur, the atomic ratio of calcium to sulphur being within the range 0.5 : 1 to 2 : 1.

Closely-related art appears in each of D1-D4. However, in none of these documents is there explicit disclosure of an aqueous dispersion with the atomic ratio of calcium to sulphur within the above range. Furthermore, it would not be obvious to a person skilled in the art to prepare such a dispersion. Consequently, claims 1-7, 14 and 16 appear to be novel and involve an inventive step.

NOVELTY(N) and INVENTIVE STEP(IS) Claims 8-13, 15 and 17 :-

Claim 8 defines a composition comprising an aqueous dispersion of rock lime, described as non-amorphous calcium carbonate (eg marble) at page 5 lines 26-29. The average diameter of the rock lime particles is required to be less than 10 µm while the maximum particle size is 50 µm. The composition is required to be suitable for soil conditioning.

In example 4 of D5 an aqueous suspension of marble chips is subjected to two successive grinding operations to yield particles 84% of which are less than 2 µm in diameter and 96% of which are less than 10 µm. These values appear to meet the average particle diameter requirements of the above claims. This being so, there appears no reason why such a suspension should not be suitable for soil conditioning. Consequently, claims 8-13 lack novelty (as well as inventive step) when compared to D5.

VI. Certain documents cited**1. Certain published documents (Rule 70.10)**

Application No. Patent No.	Publication date (day/month/year)	Filing date (day/month/year)	Priority date (valid claim) (day/month/year)
EP 924176	23 June 1999	11 December 1998	18 December 1997

This citation discloses a soil conditioner comprising an aqueous suspension of calcium carbonate with median particle size of less than 10 microns, and is thus relevant to claims 8-13, 15 and 17 if the priority of any of these claims comes into question.

2. Non-written disclosures (Rule 70.9)

Kind of non-written disclosure	Date of non-written disclosure (day/month/year)	Date of written disclosure referring to non-written disclosure (day/month/year)
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VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claims 1 and 14 are not supported by the description as the particles of calcium carbonate and sulphur are not necessarily very small as required by page 7 lines 12-27 and elsewhere in the specification.

Claims 8 and 15 are not supported by the description as the specification gives no indication of how the fine rock lime particles are obtained, how the average particle diameters are measured nor how particles larger than 50 μm are excluded..

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

C ntinuation of V

In example 5 of D6 marble chips are ground in water to yield a suspension in which 92% of particles are smaller than 2 μm but 0.6% are larger than 53 μm . Although this may conflict with the maximum particle size in claim 8, the choice of 50 μm as the maximum appears somewhat arbitrary as the specification gives no reason to support this value. In the absence of any benefit conferred on the suspension by a maximum particle size of 50 μm , claims 8-13 lack an inventive step when compared to D6.

Neither D5 or D6 disclose a method for increasing the pH of agricultural soils as defined in claims 15 and 17. Consequently, these claims are not deprived of novelty by these citations.

However, it would be obvious to a person skilled in the art to use such compositions in agriculture as it is common general knowledge to increase the pH of agricultural soils by applying lime in a finely-ground state. Consequently, claims 15 and 17 lack inventive step when compared to the above citations.

PATENT COOPERATION TREATY

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NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

FREEHILLS CARTER SMITH & BEADLE
101 Collins Street
Melbourne, VIC 3000
AUSTRALIE

Date of mailing (day/month/year) 13 February 2001 (13.02.01)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 40443295dgct	
International application No. PCT/AU00/00683	International filing date (day/month/year) 16 June 2000 (16.06.00)

1. The following indications appeared on record concerning:		
<input checked="" type="checkbox"/> the applicant	<input checked="" type="checkbox"/> the inventor	<input type="checkbox"/> the agent <input type="checkbox"/> the common representative
Name and Address MCDONALD, Glen, Stuart 1 Filomena Court Cranbourne North, VIC 3977 Australia	State of Nationality AU	State of Residence AU
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	
2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:		
<input checked="" type="checkbox"/> the person	<input type="checkbox"/> the name	<input type="checkbox"/> the address <input type="checkbox"/> the nationality <input type="checkbox"/> the residence
Name and Address MCDONALD, Glenn, Stuart 1 Filomena Court Cranbourne North, VIC 3977 Australia	State of Nationality AU	State of Residence AU
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	
3. Further observations, if necessary:		
4. A copy of this notification has been sent to:		
<input checked="" type="checkbox"/> the receiving Office	<input type="checkbox"/> the designated Offices concerned	
<input type="checkbox"/> the International Searching Authority	<input checked="" type="checkbox"/> the elected Offices concerned	
<input checked="" type="checkbox"/> the International Preliminary Examining Authority	<input type="checkbox"/> other:	

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Claudio Borton
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PCT COOPERATION TREATY

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NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
 US Department of Commerce
 United States Patent and Trademark
 Office, PCT
 2011 South Clark Place Room
 CP2/5C24
 Arlington, VA 22202
 ETATS-UNIS D'AMERIQUE
 in its capacity as elected Office

Date of mailing (day/month/year)

13 February 2001 (13.02.01)

International application No.

PCT/AU00/00683

Applicant's or agent's file reference

40443295dgct

International filing date (day/month/year)

16 June 2000 (16.06.00)

Priority date (day/month/year)

18 June 1999 (18.06.99)

Applicant

STRACHAN, Graham, George et al

1. The designated Office is hereby notified of its election made:



in the demand filed with the International Preliminary Examining Authority on:

16 January 2001 (16.01.01)



in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
 34, chemin des Colombettes
 1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Claudio Borton

Telephone No.: (41-22) 338.83.38

LIQUID SOIL CONDITIONER

Technical Field

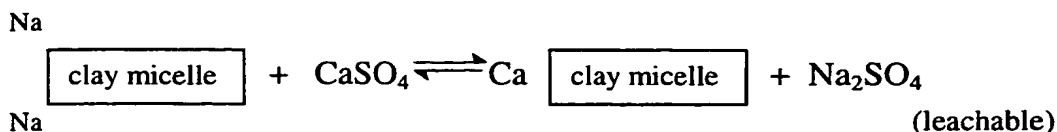
This invention relates to liquid soil conditioners for agricultural use and more particularly to liquid soil conditioners comprising of aqueous suspensions of non amporhous calcium carbonate. The invention also relates to methods of treating agricultural land to improve its productivity.

Background to the Invention

Many soils have what is known as poor structure. This is characterised by low water penetration, surface crusting when dry, restricted root growth of plants and poor germination of seeds. It is desirable to improve soils having poor structure. Soils may also be deficient in that their acidity is too high, i.e. the pH is too low. For many agricultural uses a pH of about 6.5 is considered optimum. Many soils are acid with pH of 5.5 or less. It is hence desirable to raise the pH of acid soils.

It is known that a high sodium content in the soil is a primary cause of poor structure. When a soil with high sodium content becomes wet, very fine clay particles disperse into the soil water. They are transferred with this water and settle out in the fine pores between the soil particles. This causes the pores to become blocked. The soil becomes dense, and the movement of water, air, plant roots and tillage equipment is significantly hindered. This reduces the productivity of whatever crop or pasture is growing on that area. Clay soils fall into this category of soils.

Gypsum which is calcium sulfate has traditionally been used to improve the friability or structure of clay soils by reducing the sodium levels in the soil. The calcium ions formed from the disassociation of the gypsum displace the sodium ions from the surface of the clay particles. The sodium can then be eluted through the soil. The bound calcium allows the clay particles to link into a lattice network of particles resulting in a more open soil structure.



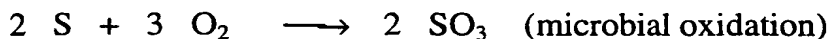
Typically gypsum is used in a granular form and must be applied at very high rates, commonly about five tonnes per hectare in heavy clay soils. It can therefore be difficult and expensive to spread.

Furthermore, it is not feasible to apply bulk gypsum in many situations, as the spreading equipment is too large. For example, in many vineyards the rows of vines are too close together to allow access for a large vehicle.

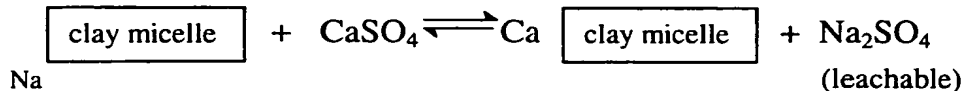
A further problem with granular gypsum is that it may take twelve months or more to become effective as the particle size is relatively large. The effectiveness of the gypsum in exchanging the sodium ions in the clay is directly related to the surface area of the gypsum exposed to the clay. Finer particles have a greater surface area than larger particles for the same given weight of gypsum.

Gypsum particles are typically of the order of 1mm diameter (1000 micron) or more. Although, finer particles could be produced by milling, the gypsum dust produced by this process can cause difficulties in application. Furthermore, the application of granular gypsum can cause soil compaction from the spreading machines. The spreading machines are usually heavy as they carry several tonnes of gypsum. The compaction caused by the tyres can be substantial. Those areas which become compacted are difficult to be planted with crops unless the soil is further tilled and returned to its uncompacted state.

Other products which can be used to displace sodium ions are available as alternatives to gypsum, but they have major disadvantages. For example, sulfur may be applied to soil for conditioning purposes. Sulfur undergoes microbial oxidation in soil to form sulfuric acid which in turn may react with lime (if any) present in the soil to form calcium sulfate, gypsum. It is usually only added to soil if it is deficient in sulfur. However, sulfur powder is generally difficult to spread.

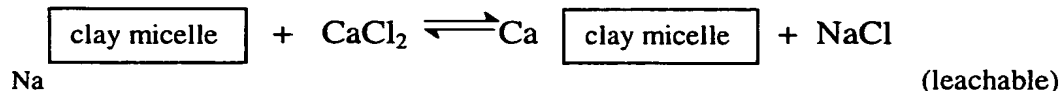


Na



Sulfuric acid may also be directly applied to soil. Upon application to soils containing calcium carbonate, it reacts to form calcium sulfate. However, being a strong acid, it is difficult to work with, requiring special acid resistant equipment. Calcium chloride forms calcium ions on addition to soil and these displace the sodium ions in the clay in the same way as the calcium ions from gypsum do. However, the residual product from this reaction is sodium chloride. Salinity is already a major problem in many agricultural areas and, for most users, the application of calcium chloride is not a viable option to address a clay problem.

Na



With regard to the treatment of acid soils, one method used is to apply granulated limestone (CaCO_3). However, the usual particle size of this material leads to the material having to be applied at very high rates. Furthermore, with this known treatment the pH tends to change relatively slowly, taking up to twelve months to lead to significant improvements. The requirement of large application rates causes similar difficulties to those discussed earlier for the application of gypsum.

Other methods have been proposed to improve the agricultural productivity of soil by adding soil conditioners.

Australian Patent 691460 discloses the application of an aqueous dispersion

of calcium carbonate in a special precipitate form. A number of additives may be included in this formulation and these include well known agricultural materials such as herbicides, insecticides, metals and chelates. Sulfur is also mentioned as an optional additive when the soil is deficient in sulfur. The purpose of these compositions is to increase the pH of the soil. The relative quantities of the additives are not set out.

French Patent 2372131 relates to a special blend of three ingredients, two of which are sulfur and calcium carbonate. The volume ratio of calcium carbonate to sulfur in their blend is 3 to 1.

Canadian Patent CN 1113221 and CN 11136028 disclose foliar spray compositions for agricultural use. These are quite different from the soil applied soil conditioner of the present application.

Australian Patent 630806 discloses agricultural compositions based on deposit lime. In this patent they claim much greater efficacy for deposit lime compared to rock lime. They state that rock lime is essentially ineffective when used in their aqueous slurries.

The object of the present invention is to avoid some of the problems associated with the use of the above products.

Summary of the Invention

This invention provides in one form a liquid soil conditioning composition in the form of an aqueous dispersion of calcium carbonate and sulfur wherein the atomic ratio of calcium to sulfur is in the range 0.5 : 1 to 2.0 : 1.

Preferably the atomic ratio of calcium to sulfur is in the range 0.75 : 1 to 1.5 : 1.

More preferably the atomic ratio of calcium to sulfur is in the range 0.9 : 1 to 1.3 : 1.

Preferably the composition includes a suspension or dispersing agent.

Preferably the suspension or dispersing agent is selected from bentonite and polyvinylalcohol.

Preferably the calcium carbonate is in non amorphous form.

More preferably the calcium carbonate is rock lime.

In an alternative form this invention provides a liquid soil conditioning composition comprising rock lime suspended in water wherein the rock lime has particle size average diameter less than 10 μm with maximum particle size 50 μm .

Preferably the average diameter is less than 5 μm with maximum particle size 25 μm .

Preferably the composition further comprises a suspension or dispersing agent that is a water soluble polymer.

Preferably the water soluble polymer is polyvinylalcohol. Preferably the composition comprises 700 – 1000 g/litre of water of calcium carbonate.

Preferably the amount of calcium carbonate is about 900 g/litre of water.

In a further alternative form this invention provides a method of improving soil agricultural productivity of clay soils without substantially changing the pH of the soil by applying an effective amount of a liquid soil conditioning composition in the form of an aqueous dispersion of calcium carbonate and sulfur wherein the atomic ratio of calcium to sulfur is in the range of 0.5 : 1 to 2.0 : 1.

In a still further form this invention provides a method of increasing the pH of agricultural soils by applying an effective amount of a liquid soil conditioning composition comprising rock lime suspended in water wherein the rock lime has particle size average diameter less than 10 μm with maximum particle size 50 μm .

20 Detailed Description of the Invention

The invention will now be described in greater detail with reference to a particularly preferred embodiment in the form of an aqueous liquid dispersion or suspension. 900 grams of superfine rock lime was added per litre of water and blended in combination with one or more suspension and dispersion agents such as polyvinylalcohol. While 900 g/litre produces useful compositions of up to 1500 g/litre can also be used. Rock lime is a term known in this art field to include calcium carbonate as found in nature where there is a significant degree of crystallinity. An example is marble. This calcium carbonate is non amorphous and thus different from deposit lime which is the result of sedimentary deposits. It will be appreciated that there are varying extents of crystallinity as the material is classified as a metamorphic material. It will also be appreciated that the suspension

agent polyvinylalcohol is usually in the form of a partially hydrolysed polyvinylacetate polymer. Typically 90% of the acetate esters are hydrolysed to produce a water soluble dispersion. In the above preferred composition polyvinylalcohol 12g is added. The pH is then adjusted to 9 by the addition of potassium hydroxide. Other suspension agents may be used. Examples include cellulosic derivatives such as hydroxyethylcellulose. Other suspension agents may be used and examples are bentonite, and ionic and non ionic surfactants. The selection of appropriate suspension agents will be made by taking into account cost effectiveness. To this dispersion, about 250 grams of sulfur powder, combined with a wetting agent to assist in dispersion, was blended into the dispersion. The wetting agent can be selected from this well known class of material that includes ionic and non ionic agents. The quantities described in the preferred embodiment above result in a liquid with a calcium content of about 35% and a sulfur content of about 25%. This provides an atomic ratio of calcium to sulfur of 1.15 : 1. The atomic ratio is calculated by dividing the weight ratio by the atomic weight of calcium and sulfur respectively. The calcium carbonate and sulfur are preferably a superfine grade with an average particle size of about 5 microns. The fine particle size allows the aqueous dispersion of the invention to be used readily in installations where fine filters are in place and allows the dispersion to be used in a wide range of current machinery without the need for modification or adjustment thereof. Of course, dependent on the soil requirements, coarser particle sizes can be used and larger particle sizes would still be effective providing of course any necessary modifications to equipment, including alterations of filters were taken into account.

The dispersion of the invention is applied to the soil optionally with the aid of a suspension agent such as polyvinylalcohol and directed onto the soil by way of spray or drip such that the dispersion is allowed to migrate into the soil structure thereby being exposed to oxygen and accordingly the oxidation process is effected in situ throughout the structure of the soil allowing for the formation of calcium sulfate (gypsum) in situ within the structure of the soil.

The method of the invention allows the blend of calcium carbonate and sulfur, when applied to the soil, to result in a similar reaction to that of gypsum

applied directly to the soil. However, the application of an aqueous solution provides vastly improved delivery means and avoids many of the difficulties of applying gypsum or the application of sulfur powder per se to the soils. In the first instance, the application of an aqueous solution is far more controllable by way of piping or spray delivery than that of gypsum powder. The liquid delivery of the dispersion of the invention can of course be applied through irrigation, boom sprays or any other available system where water is applied to plants or soils. Accordingly, a wide variety of commercial growers and other potential users, who would not previously have envisaged using gypsum, now have access to a greatly improved delivery method and dispersion product to assist them in breaking down and treating their clay soils.

The very small particle size of the calcium carbonate and sulfur components of the dispersion results in a far more rapid response than the use of traditional gypsum which uses a far greater particle size. The exchangeable sodium percentage (ESP) is a common measure of the soil sodium level in a soil. A soil with high ESP will generally have poor water penetration and will develop surface crusting and be difficult for most root systems to penetrate and productively grow. The methods and formulations of the invention are able to substantially reduce the ESP value in a period of 4 weeks with a single application. Field trials have demonstrated the superior performance of the dispersion and method of the invention when contrasted with bulk gypsum. The composition of the example described above was applied to a heavy clay soil at rates of 40 l/acre and 60 l/acre relative to an untreated control and soil treated with gypsum at a conventional application rate. The ESP of the soil was test after four weeks. The results were 11.5 for the control, 11.5 for the conventional gypsum treatment, 8.9 for the example of this invention at the lower application rate and 8.51 for the example of this invention at the higher application rate.

In this invention the calcium carbonate need not contain exclusively calcium as the metal and minor amounts of magnesium can be included without detracting significantly from the effectiveness of the product. For example, dolomite which is form of calcium that contain magnesium carbonate may be used.



Tests have shown that when the dispersion of the invention is applied and the methods used there is no appreciable change in the pH of the soil 4 weeks after use.

Although calcium carbonate is an alkaline product and may be expected to increase the alkalinity of the soil, this effect is offset by the conversion of the sulfur in the dispersion product to sulfuric acid and any pH changes are therefore buffered.

The product can be used in a wide range of situations including home gardens where the dispersion of the invention could be applied by way of a watering can or with a provision of a ready to use hose pack. Alternatively, the dispersion could be applied directly to the soil from a squeeze bottle and hosed in afterwards.

All of the applications of the invention are far more convenient and environmentally friendly than using and spreading bulk gypsum.

Finally as an alternative to the preparation of calcium sulfate in situ, a superfine gypsum could be applied to the soil by way of an aqueous dispersion directly. However, the end product would have a lower concentration of calcium and sulfur than in the particularly preferred dispersion and methods of the invention.

For example, the application of superfine gypsum directly would result in between 15 and 22% calcium and 10 and 17% sulfur, whereas the dispersion of the invention provides a 35% calcium delivery and 25% sulfur delivery.



THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A liquid soil conditioning composition in the form of an aqueous dispersion of calcium carbonate and sulfur wherein the atomic ratio of calcium to sulfur is in the range 0.5 : 1 to 2.0 : 1.
2. A liquid soil conditioning composition as defined in claim 1 wherein the atomic ratio of calcium to sulfur is in the range of 0.75 : 1 to 1.5 : 1.
3. A liquid soil conditioning composition as defined in claim 2 wherein the atomic ratio of calcium to sulfur is in the range 0.9 : 1 to 1.3 : 1.
4. A liquid soil conditioning composition as defined in any one of claims 1 to 3 wherein the composition includes a suspension or dispersing agent.
5. A liquid soil conditioning composition as defined in claim 4 wherein the suspension or dispersing agent is selected from bentonite and polyvinylalcohol.
6. A liquid soil conditioning composition as defined in any one of claims 1 to 5 wherein the calcium carbonate is in non amorphous form.
7. A liquid soil conditioning composition as defined in claim 6 wherein the calcium carbonate is rock lime.
8. A liquid soil conditioning composition comprising rock lime suspended in water wherein the rock lime has particle size average diameter less than 10 μm with maximum particle size 50 μm .
9. A liquid soil conditioning composition as defined in claim 8 wherein the average diameter is less than 5 μm with maximum particle size 25 μm .

10. A liquid soil conditioning composition as defined in claim 8 or claim 9 wherein the composition further comprises a suspension or dispersing agent that is a water soluble polymer.

5 11. A liquid soil conditioning composition as defined in claim 10 wherein the water soluble polymer is polyvinylalcohol.

12. A liquid soil conditioning composition as defined in any one of claims 9 to 11 wherein the composition comprises 700 – 1000 g/litre of water of calcium
10 carbonate.

13. A liquid soil conditioning composition as defined in claim 12 wherein the amount of calcium carbonate is about 900 g/litre of water.

15 14. A method of improving agricultural productivity of clay soils without substantially changing the pH of the soil by applying an effective amount of a liquid soil conditioning composition in the form of an aqueous dispersion of calcium carbonate and sulfur wherein the atomic ratio of calcium to sulfur is in the range of 0.5 : 1 to 2.0 : 1.

20 15. A method of increasing the pH of agricultural soils by applying an effective amount of a liquid soil conditioning composition comprising rock limestone suspended in water wherein the rock lime has particle size average diameter less than 10 µm with maximum particle size 50 µm.

25 16. A method of improving agricultural soil productivity of clay soils as defined in claim 14 when the liquid soil condition composition is defined as in any one of claims 2 – 7.

30 17. A method of increasing the pH of agricultural soils as defined in claim 15 wherein the liquid composition is defined as in any one of claims 9 – 13.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU00/00683

A. CLASSIFICATION OF SUBJECT MATTERInt. Cl. ⁷: C09K 17/06, 17/02; C05G 3/04; C05D 3/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C09K 17/- C05D 3/- C05G E02D E21B; C09K 17/00 (1920-75) C05D 3/02 (1920-75)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU : C09K 17/00, C05D 3/-Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT, JAPIO, (IPC plus Keywords), USFULLTEXT**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AU 36066/97 B (MURDOCH) 14 May 1998. See Claim 1	1-17
X	FR 2372131 A (MARTYNIAC) 23 June 1978. See page 1 lines 4-12 and page 4 lines 2-8.	1-17
X	Derwent abstract accession no. 81-42710 D/24, Class E36, J56043340 A (TOKAI RUBBER). See abstract.	1-4

☒ Further documents are listed in the continuation of Box C
 ☐ See patent family annex

* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed		"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
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Date of the actual completion of the international search
24 July 2000Date of mailing of the international search report
- 7 AUG 2000

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU00/00683

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CA 2044048 A (SHELL CANADA) 12 July 1992. See page 1 lines 15-17, claim 5.	1-4
X	Derwent abstract accession no. 97-403450/38, Class C04, CN 1113221 A (ZHANG).	1-3
X	Derwent abstract accession no. 98-0335458/04, Class C04, CN 1136028 (SHI).	1-3
A	DE 4029955 A (SKW TROSTBERG) 26 March 1992.	
A	AU 17788/76 A (Canadian Superior Oil) 23 March 1978.	